**Instructions**: Complete each of the following exercises for practice.

1. Find the equation of the sphere centered at the point $(1, 2, 3)$ and which passes through the origin.
2. Find the side lengths of $\triangle PQR$; classify as right, isosceles, equilateral, or none of these.

   (a) $P = (3, -2, -3)$, $Q = (7, 0, 1)$, $R = (1, 2, 1)$ (b) $P = (2, -1, 0)$, $Q = (4, 1, 1)$, $R = (4, -5, 4)$

3. Determine whether the points below lie on a straight line.

   (a) $A = (2, 4, 2)$, $B = (3, 7, -2)$, $C = (1, 3, 3)$ (b) $A = (0, -5, 5)$, $B = (1, -2, 4)$, $C = (3, 4, 2)$

4. Show that the equation below represents a sphere, and find its center and radius.

   (a) $x^2 + y^2 + z^2 - 2x - 4y + 8z = 15$ (b) $3x^2 + 3y^2 + 3z^2 = 10 + 6y + 12z$

5. Write inequalities to describe the region below.
   (a) The region between the $yz$-plane and the vertical plane $x = 5$.
   (b) The cylinder on or below plane $z = 8$ and on or above the disk about the origin of radius 2 in the $xy$-plane.
   (c) All points between but not on the spheres of radius $r$ and $R$ centered at the origin, where $r < R$.
   (d) The solid upper hemisphere of the sphere of radius 2 centered at the origin.